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ABSTRACT

With the recent increase in the number of students wishing to enter vocational programs and the increased pressure on accountability and efficiency, vocational educators need to reexamine their policies regarding the selection and admission of students. Several considerations that complicate these decisions are (1) open-door policies that exist in some states; (2) selection of students on the basis of their potential for employment in a training-related occupation; (3) varying philosophies of selection and admission; (4) scarcity of studies in this area since 1972; and (5) the effect affirmative action laws have had on policies and testing. Among main topics discussed are basic strategies underlying studies to identify selection and admission criteria and a review of the literature of prediction studies and classification studies. Results of the literature review are mixed, depending upon whether one is speaking of predictive studies or classification studies. But there appears to be promise for predicting success by using information classification methodologies. Before using the conclusions of past research in developing future policies, though, it is important to remember that much of the research of the past was done before affirmative action legislation raised the issues of sex bias, race bias, or representation of the handicapped and disadvantaged. (CT)

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Information Series No. 212

REVIEW AND SYNTHESIS OF CRITERIA USEFUL FOR THE SELECTION AND ADMISSION OF VOCATIONAL STUDENTS

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FOREWORD

The Educational Resources Information Center on Adult, Career, and Vocational Education (ERIC/ACVE) is one of sixteen clearinghouses in a nationwide information system that is funded by the National Institute of Education. One of the functions of the Clearinghouse is to interpret the literature that is entered in the ERIC data base. This paper should be of particular interest to administrators, counselors, and state education department supervisors of vocational education.

The profession is indebted to David Pucel for his scholarship in the preparation of this paper. Recognition also is due Jerome Kapes, Texas A & M University; J. Stanley Ahmann, Iowa State University; and Frank Pratzner, The National Center for Research in Vocational Education, for their critical review of the manuscript prior to its final revision and publication. Robert D. Bhaerman, Assistant Director for Career Education at the ERIC Clearinghouse on Adult, Career, and Vocational Education, coordinated the publication's development.

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ABSTRACT

With the recent increase in the number of students wishing to enter vocational programs and the increased pressure on accountability and efficiency, vocational educators need to reexamine their policies regarding the selection and admission of students. Several considerations that complicate these decisions are (1) open-door policies that exist in some states; (2) selection of students on the basis of their potential for employment in a training-related occupation; (3) varying philosophies of selection and admission; (4) scarcity of studies in this area since 1972; and (5) the effect affirmative action laws have had on policies and testing. Among main topics discussed are basic strategies underlying studies to identify selection and admission criteria and a review of the literature of prediction studies and classification studies. Results of the literature review are mixed, depending upon whether one is speaking of predictive studies or classification studies. But there appears to be promise for predicting success by using information classification methodologies. Before using the conclusions of past research in developing future policies, though, it is important to remember that much of the research of the past was done before affirmative action legislation raised the issues of sex bias, race bias, or representation of the handicapped and disadvantaged. (CT)

Descriptors: *Admission (School); *Admission Criteria; Enrollment Influences; Open Enrollment; *Selective Admission; *Affirmative Action; *Educational Policy; Program Evaluation; *Vocational Education; Prediction

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INTRODUCTION

Making choices is often a difficult process, and students choosing occupations or vocational school personnel choosing students are no exceptions. The basic characteristic that makes choices difficult is that they have consequences. There are many positive consequences connected with an individual selecting an appropriate occupation or vocational school personnel selecting a person to enter an appropriate vocational program. When a person succeeds in an occupation and is satisfied, the person becomes a productive member of society and is happy in that particular role. If the person selects an inappropriate occupation, the likelihood of that person being both satisfied with his or her employment and being a satisfactory employee is greatly minimized. If vocational school personnel select a student who cannot succeed in a training program, that decision may have negative consequences. Another student with the ability to succeed may be excluded from the program. Financial and other resources may be devoted to an individual who never utilizes the training. The challenge is to identify and develop aids that will be useful to individuals as they select occupations and to vocational school personnel as they select and counsel students. In this way, the time and resources of both the individuals and vocational schools are best utilized.

With an increase in the number of students wishing to enter vocational programs in recent years and the increased pressure on accountability and efficiency, vocational educators are faced with the need to reexamine their policies regarding the selection and admission of students. At first glance, the solution seems simple: select and admit those students with the highest probability of success. However, the solution is not that simple. The following are some of the considerations that complicate decisions concerning the selection and admissions process.

First, some states, such as Minnesota, have open-door policies. Under such a policy, the selection of only the "best" students is prohibited.

Second, since there is disagreement on the most desirable outcome of vocational education, it is not always possible to define which are the "best" students to admit to vocational programs. Some argue that students should be selected on the basis of their potential for employment in a training related occupation. Others argue that people should be selected not only on this basis, but also on the basis of the personal satisfaction they might get from the program or the occupation. Others argue that only students who are most likely to succeed in the training program should be selected. They do not consider themselves accountable for postgraduation placement or the type of employment the students eventually find. Therefore, the goal of effective vocational education selection and admission practices is not always clear. This causes difficulty in determining which goal(s) should be pursued.

Third, there is general disagreement concerning philosophies of selecting and admitting vocational students. For example, some people believe that the types of data discussed in this paper should be used exclusively by schools as they select and admit students from a pool of potential students. Others believe that the data should be used as part of a counseling process involving potential students. Based on the data, potential students can decide which vocational programs they wish to enter, and the schools automatically admit these students to the programs they have chosen. This paper will not attempt to resolve this and other philosophical issues concerning how the data reviewed should be used in selection and admission. It is designed to determine which types of data have been found to relate to success in vocational programs. Such data can be used by individuals with a variety of different philosophies.

A fourth concern of the reader should be that most of the studies on selection and admission criteria for vocational programs were done prior to 1972. An exhaustive review of the literature revealed few studies after that time. Therefore, the data currently available need updating.

Fifth, affirmative action pressures have had far-reaching effects on the selection and admission policies of vocational schools at all levels. Affirmative action laws mandate equal opportunity for all and prescribe that certain guards be built into educational practices. Vocational education, more than any other type of educational program, has been the focus of affirmative action criticism. Because of this criticism, Title IX incorporated language explicitly prohibiting sex bias in

vocational schools.

McClure wrote "Vocational education historically and presently reinforces and perpetuates not only the prevailing stereotypes as to the socially acceptable occupations for women and minorities, but also the race and sex discrimination in the labor market fostered by employer and union practices" (McClure, 1977, p. 3). Matthews and McCune made the following claim: "Vocational education, which provides a direct link between education and the employment system, is one of the most sex-segregated of all education programs. Of the 136 instructional categories within the nation's vocational education programs, 71 percent have enrollments of at least 75 percent one sex or the other; almost one-half have enrollments over 90 percent one sex or the other" (Matthews and McCune, 1976, p. 7).

As a result of a suit filed against the Department of Health, Education, and Welfare in 1973 for its failure to enforce Title VI of the Civil Rights Act of 1964 (Adams vs. Califano), guidelines that explain the civil rights responsibilities of recipients of federal funds offering or administering vocational education programs were published (Federal Register, 1979). The guidelines were issued to meet the requirement of the court order arising from the case. The rationale for the guidelines indicates that an investigation of civil rights violations in vocational education for 1973 to 1978 consistently found civil rights violations in vocational schools (p. 17163). The essence of these guidelines is summarized in the following quote:

> Recipients may not judge candidates for admission to vocational education programs on the basis of criteria that have the effect of disproportionately excluding persons of a particular race, color, national origin, sex, or handicap. However, if a recipient can demonstrate that such criteria have been validated as essential to participation in a given program and that alternative equally valid criteria that do not have such a disproportionate adverse effect are unavailable, the criteria will be judged nondiscriminatory (p. 17166)

Affirmative action criticisms and the Office of Civil Rights Guidelines for Vocational Education have a direct bearing on the utility of past research findings for use in current selection and admissions practices. The need to address affirmative action issues was not well defined when much of the research regarding selection and admission criteria was being conducted. One needs to be aware of this when reviewing past research.

Much of this research examined the ability of certain information, gathered on individuals prior to their admission to a vocational program, to predict their success in the program. This is a logical and widely accepted procedure. However, such studies utilized groups enrolled in vocational programs prior to affirmative action claims. These groups, therefore, may be composed of disproportionate numbers of males; also, a proportionate number of minority groups may not be represented. This does not mean that researchers were purposely segregating groups, but it means the research was based on groups that probably did not have the sex, minority, etc. representation that is essential today. Therefore, the use of normative data and other information generated by these studies is often criticized on the grounds that it will perpetuate the same types of discrimination that were prevalent in the past since selection for admission to those programs will be based on information obtained from the same "segregated" sample.

Although few people have studied ways of removing such bias from tests and associated norms, Tittle (1978) and Tittle and Zytowski (1978) studied the issues involved in the development of sex-fair tests. They suggest that in order to remove sex bias from test instruments used in counseling, checklists, which could be used as aids in judging the sex-fairness of a test, should be developed for test developers and users. Tittle and Zytowski also provide insights into some methods that might be used to remove bias in all phases of test development and implementation.

The above discussion was not meant to discourage the investigation and adoption of selection and admission criteria. Rather, it was meant to point out that one should not blindly implement the results of previous research without first considering the research findings within the broader context of school policy and philosophy. With these cautions in mind, the remainder of this paper addresses what the literature has to say about criteria for selecting and admitting vocational students.

BASIC STRATEGIES UNDERLYING STUDIES TO IDENTIFY SELECTION AND ADMISSION CRITERIA

The literature reveals two related but different approaches to determining selection and admission criteria. The first approach is that of predicting the success of a student within a particular vocational training program or occupation. This type of study tries to identify information that can be used to determine a person's chances of success in a particular occupation. The data attempt to determine which characteristics mark the successful versus the unsuccessful in various programs. The more a student displays those characteristics identified with "success" in a program, the more likely the student is to succeed. These studies are usually conducted using correlation or regression analysis procedures and often provide expectancy tables.

Let us review a simple example using the single variable of mechanical ability to predict success. The major question is, What are the student's chances of succeeding in programs A, B, or C? The student takes the mechanical ability test and gets a score of fifty. This score is compared with information gathered from students enrolled in the program in the past. The student finds that people with a score of fifty tend to succeed in program A 30 percent of the time, in program B 50 percent of the time, and program C 50 percent of the time. That information can be used by the school or the student in deciding which, if any, of the programs the student should enroll in.

The second approach attempts to classify potential students in terms of their similarity to people who have been successful. Information gathered from a potential student is compared to similar information gathered from people considered "successful" in a variety of training programs or occupations. The assumption is that the more similar a person is to the typical

successful person in a training program or occupation, the more likely the person is to be successful. The less similar a person is to the typical person who is successful in the occupation, the less likely the person is to be successful. This approach is most often used to help a student determine which of a number of possible training programs he or she should consider most seriously. Studies of this type are most often conducted using procedures that yield similarity indexes. These procedures include various discriminant analysis, Centour analysis, and profile analysis. Although this procedure most often considers a number of variables simultaneously, we will focus again on mechanical ability to parallel our previous example. The student takes the mechanical ability test and gets a score of fifty. That score is then compared with the distributions of scores of successful people in programs A, B, and C. Figure 1 presents a graphic description of the distribution of scores over the three programs.

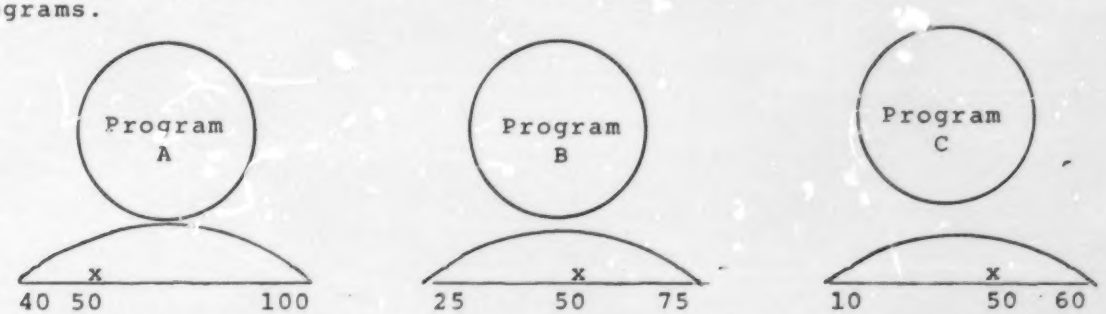

Figure 1. Distribution of scores over three sample programs.

As figure 1 shows, this score is a lower score than that typically obtained by people who succeed in program A. It is an average score in terms of the people who typically succeed in program B and a higher score than that typically obtained by people in program C. Therefore, the student's score is more similar to that of a person who typically succeeds in program B. The student would be advised to investigate that program further, or that student might be selected to enroll in program B. This procedure is based on the assumption that it is possible to have too much as well as too little of a given characteristic to be successful in an occupation.

In summary, classification studies describe how similar a student is in terms of specific characteristics to typical people in an occupational or training area. Prediction studies attempt to indicate a person's chance of success in an occupational or training area using specific characteristics to make the prediction.

The debates over which approach is the best have continued over many years. A more complete description of the two methodologies is presented in Multivariate Statistics for Personnel Classification (Rulon et al., 1967). Although thorough discussion of the pros and cons of both methodologies is not warranted in this paper, one must be aware of these two basic strategies when reviewing literature regarding criteria for the selection and admission of vocational students.

REVIEW OF THE LITERATURE

A review of the literature indicates a dearth of reliable information that can be used by vocational personnel to help a student select a vocational training program or to aid vocational school personnel in selecting and admitting students. The existing information is sporadic and does not contain sufficient evidence to indicate that one or more specific instruments can be used across vocational programs. Efforts at establishing an empirical relationship between training versus job success or previously gathered counseling versus selection information have been limited in scope. Therefore, the task of abstracting generalizations from past studies in the counseling and selection of students for a wide range of vocational programs is indeed difficult.

It is apparent from the literature that many people believe an empirical relationship can be established between measures of future success and measures of certain individual abilities and needs. Many research studies that explore such relationships have been done. However, these studies have used various types of instruments to measure many different abilities or traits, and they have tried to predict success according to several different criteria. In addition, several different instruments have been used to measure the same ability or trait. The use of such a wide variety of instruments and such a large number of measures of success, multiplied by the large number of occupations and training programs that have been studied, has resulted in very little replicated data concerning any one occupation or training program.

The absence of replicated information makes it virtually impossible to make precise statements about selection and admission criteria to be used with a given occupation or training program. However, the information that does exist, even though it is nonidentical, can be logically summarized

to give a person a "feel" for the way abilities and needs seem to relate to certain training programs or jobs. The following review of the literature is presented in light of these limitations. It is presented in two sections, one on prediction studies and the other on classification studies.

Prediction Studies

The majority of the reported research has utilized the prediction model format, which is aimed at optimizing selection in terms of a persons' potential to succeed in training or on the job. First, a number of previously conducted in-depth reviews of portions of this literature are presented. Although it is always risky to rely on others' conclusions when one is conducting one's own review of the literature, the reviews that have been selected have withstood substantial scrutiny from the field and have been accepted as fair summaries of past studies. In addition, summaries of other studies found in the literature, which were not contained in these earlier reviews, are presented.

Prediger et al.(1968) conducted a review which identified variables that could be used in counseling and in admitting high school students to vocational programs. He identified tests that had been used in the past for counseling and admissions and categorized them into ten categories. Occupational areas in which enough selection studies had been done to summarize results were sorted into eleven categories. Zero order correlations between each type of measure and success in high school training programs were reported. About 2,000 studies conducted between 1954 and 1967 were reviewed and reported.

The ten test categories were as follows:

1. V-INTEL - verbal intelligence and/or academic aptitude.
2. NV-INTEL - nonverbal intelligence and abstract reasoning.
3. ARITH - arithmetic reasoning and computation.
4. SPACE - spatial aptitude including spatial visualization, spatial relations.
5. MECH - mechanical principles, comprehension, knowledge, reasoning, etc.
6. PERCEPT - perceptual speed and accuracy.
7. DEXT - manual dexterity including mark making and finger, hand, and arm dexterity
8. GPA - grades for varying amounts of coursework.
9. ACH - achievement test data which usually fall in the areas of reading, spelling, and English grammar.
10. SPEC - special tests, which been standardized to some degree.

Prediger then clustered the training programs into eleven categories which were formulated to preserve as much data as possible without destroying the meaningfulness of the groupings through gross heterogeneity. Each of the eleven program categories is followed by examples of course titles placed in a category. The categories not only include vocational programs but such practical arts programs as industrial arts, business education, and home economics.

1. Auto mechanics - auto shop, mechanics, automobile, auto diesel.
2. Carpenty - woodworking, woodshop.
3. Drafting - mechanical drafting, mechanical drawing.
4. Electricity - electrical, electronics, electrical construction.
5. Machine Shop - machine, machinist.
6. Industrial Arts - this is, of course, a very broad category. Whenever adequate descriptions were available, programs in this area were included in one of the categories above.
7. Business Education - this is another very broad category and covers programs with labels such as office worker, and business manager.
8. Bookkeeping - accounting.
9. Typing - all typing courses.
10. Shorthand - stenography.
11. Home Economics - from the data reported, it was impossible to determine when work in this area was vocational in nature.

The median correlation coefficients between particular predictors and particular success criteria were reported in the paper and have been summarized in table 1. For purposes of this paper, all of the median correlations above .30 have been arbitrarily underlined. A correlation of .30 was selected because such a correlation indicates that 9 percent of the variation in the criterion can be accounted for by the predictor. Many persons view a correlation of less than .30 and variance accounted for of less than 9 percent as having little practical significance in counseling or admission practices even though they may be statistically significant.

TABLE 1

SUMMARY OF THE MEDIAN CORRELATIONS
BETWEEN EACH PREDICTOR AND SOME MEASURE OF SUCCESS
FOR EACH PROGRAM*

Vocational Program	Predictors V INTEL	NV INTEL	ARITH	SPACE	MECH	PER-CEPT	DEXT	SPEC	GPA	ACH
Auto Mechanics	.20	.23	.17	.20	.23	.04	.09			.14
Carpentry	.14	.19	.06	.24	.27	.19	.18			.07
Drafting	.39	.31	.29	.42		.25	.07			.24
Electricity	.18	.21	.20	.34			.00			.24
Machine Shop	.25	.23	.35	.30	.44	.22	.14			.20
Industrial Arts	.30	.33	.29	.29	.25	.24	.10			.26
Business Education	.44	.28	.48	.23	.11	.34	.16		.44	.46
Bookkeeping	.44	.11	.29	.15		.32				.39
Shorthand	.40	.30	.38	.16		.13		.51	.56	.51
Typing	.30	.34	.36	.23	.26	.33	.20	.38		.36
Home Economics	.38	.46	.44	.36	.25	.31	.20			.42

*Where blanks occur, medians were not calculated due to insufficient data (Prediger et al., 1968). This table was modified by underlining all median correlations above .30.

Table 1 is summarized below by program:

1. Auto Mechanics - none of the abilities have been shown to correlate with success in auto mechanics above .30. Those abilities that appear most related are NV-INTEL and MECH.

2. Carpentry - none of the abilities have been shown to correlate with success in carpentry above .30. Those abilities that appear most related are SPACE and MECH.

3. Drafting - V-INTEL, NV-INTEL, and SPACE all have correlations with success in drafting above .30.

4. Electricity - only SPACE has a correlation above .30 with success in electricity.

5. Machine Shop - ARITH, SPACE, and MECH have correlations above .30 with success in machine shop.

6. Industrial Arts - V-INTEL and NV-INTEL have correlations above .30 with success in industrial arts.

7. Business Education - V-INTEL, ARITH, PERCEPT, GPA, and ACH are all correlated above .30 with success in business education.

8. Bookkeeping - V-INTEL, PERCEPT, and ACH are correlated with success in bookkeeping above .30.

9. Shorthand - V-INTEL, NV-INTEL, ARITH, SPEC, GPA, and ACH are all correlated with success in shorthand above .30.

10. Typing - V-INTEL, NV-INTEL, ARITH, PERCEPT, SPEC, and ACH are all correlated above .30 with success in typing.

11. Home Economics - V-INTEL, ARITH, SPACE, PERCEPT, NV-INTEL, and ACH are all correlated with success in home economics above .30.

Five generalizations appear to be possible:

1. Success in high school business and business related programs and practical arts programs such as general industrial arts and home economics appears to be correlated with measures such as verbal and nonverbal intelligence, arithmetic, and prior achievement.

2. Success in high school specific occupational training programs appears to be less highly correlated with intelligence and previous achievement except for drafting.

3. Success in high school occupational education programs does not appear to be correlated with manual dexterity.

4. Special aptitude tests, which require the ability to perform in areas closely related to a given occupation, appear to be correlated with success in high school vocational programs.

5. The effectiveness of a given predictor to predict success in a variety of occupations varies greatly. (For example, the correlation between verbal intelligence scores and success in carpentry was .14, while the correlation for business education and bookkeeping was .44; the correlation between nonverbal intelligence scores and success in home economics was found to be .46, while the correlation for bookkeeping was .11.)

Ghiselli (1966) conducted a literature review in which he summarized data pertaining to adults. His review covered the period from 1919 to 1966 and dealt both with prediction of success in training and on the job. He summarized the data under each of two occupational classification systems: the General Occupational Classification (GOC) and the Dictionary of Occupational Titles (DOT). Since the GOC system appears to represent a specific breakdown of occupations, it has been used in this summary. The correlation coefficients reported are based upon the mean correlation over a number of studies of a given predictor and criterion of success.

Ghiselli (1966, pp. 33-64) summarized in detail those types of measures that have predictive validity for success in various training programs and job success. He categorized measures according to the following system. It is interesting to note that his review includes personality measures as indicated in category 5.

1. Intellectual Abilities
   a. Intelligence
   b. Immediate Memory
   c. Substitution
   d. Arithmetic

2. Spatial and Mechanical
   a. Spatial Relations
   b. Locations
   c. Mechanical Principles

3. Perceptual Accuracy
   a. Number Comparison
   b. Name Comparison
   c. Cancellation
   d. Pursuit
   e. Perceptual Speed

4. Motor Abilities
   a. Tracing
   b. Tapping
   c. Dotting
   d. Finger Dexterity
   e. Hand Dexterity
   f. Arm Dexterity

5. Personality Traits

a. Personality
b. Interest

Table 2 summarizes the mean correlations between categories of measures and success in training or in success on the job for each of a number of occupations. The occupations for which data are summarized are those the author thought would be of most interest to persons concerned with vocational-technical education.

Table 2 seems to indicate that the broad categories of intellectual abilities, spatial and mechanical abilities, and perceptual accuracy are relatively efficient predictors of training success in the industrial occupations. Most of the mean correlations between these categories of measures and training success were above .30. However, few of the average correlations between these categories of measures and job success were above .30.

Ghiselli concluded that success in training is more predictable than success on the job. In most cases, the average correlation between a predictor and success in training is about .10 higher than between that predictor and success on the job. This conclusion, however, does not hold for the personality traits category. Although the data are not complete, it appears that the personality traits category predicts job success to a greater degree than training success. Ghiselli's summary appears to support Prediger's finding that motor abilities or manual dexterity have little predictive power.

Patterson (1956) also conducted a review similar to Ghiselli's. His extensive bibliography would be helpful if one wished to review individual studies in this area. The review included studies conducted between 1921 and 1954. He concluded that, as the skill level of a trade increases, there is a greater relationship between intelligence and success in that trade. In addition, he determined that manual dexterity did not seem to be highly related to success. He stated, "This means that in attempting to predict success in training for, or performance in, a skilled trade, measures of manual ability or dexterity are not as important as ability to acquire technical knowledge, ability to know when and where to apply it, with appropriate skill, and ability to understand and plan a process or job" (Patterson, 1956, p. 360). Patterson concluded that "...it should be possible to select a battery of tests which would combine to yield fair predictions of success in trade school training in any public or private school. The exact nature of such a battery may vary, depending on the level of training, and, possibly, upon the nature of the course. It would

TABLE 2

MEAN CORRELATIONS BETWEEN CATEGORIES OF MEASURES AND TRAINING AND PROFESSIONAL OR JOB SUCCESS CRITERIA

	Mechanical Repairer		Electrical Workers		Structural Workers		Processing Workers		Machine Workers		General Clerks		Sales Clerks	
	T	P	T	P	T	P	T	P	T	P	T	P	T	P
Intellectual Abilities	.40	.20	.50	.21	.29	.18	.45	.17	.36	.10	.46	.31		-.10
Spatial and Mechanical Abilities	.40	.20	.49	.18	.33	.28	.37	.18	.39	.26	.35	.14		
Perceptual Accuracy	.40	.19	.33	.27	.25	.20	.28	.19	.28	.05	.40	.26		-.05
Motor Abilities	.15	.15	.14	.16	.22	.26	.16	.29	.11	.09	.34	.16		
Personality Traits	.16		.16					.30		-.13	.17	.30		.35

T= success in training

P= success on the job in the profession

TABLE 2, con't.

MEAN CORRELATIONS BETWEEN CATEGORIES OF MEASURES AND TRAINING AND PROFESSIONAL OR JOB SUCCESS CRITERIA

	Salesperson		Protective Service		Personal Service		Vehicle Operator		Machine Tenders		Bench Workers		Packers & Wrappers	
	T	P	T	P	T	P	T	P	T	P	T	P	T	P
Intellectual Abilities		.31	.35	.23	.54	.03	.15	.14	-.31	.16	.21	.13	.48	.17
Spatial and Mechanical Abilties		.07	.34	.16	.42		.30	.20		.11	.26	.19	.46	.13
Perceptual Accuracy		.21	.30	.17		-.10	.08	.36		.18	.27	.20		.17
Motor Abilities				.19		-.05		.30	.21	.15	.42	.21		.15
Personality Traits		.27	-.13	.21		.16		.26		.26		.26		

Note: The data presented in this table were summarized from Ghiselli (1966).

probably consist of a verbal intelligence test, a test of mechanical information or experience, a test of spatial ability, and possibly an interest test" (p. 390).

All three of these reviews raise questions about the effectiveness of measures of manual dexterity in the prediction of training or on-the-job success. The literature search revealed only one study that suggested manipulative tests might be useful. This was the Kapes (1969) study conducted with ninth grade boys. It should also be noted that the norms for the General Aptitude Test Battery used by the National Employment Service include manipulative scores in numerous norms for a variety of occupations. Therefore, the utility of manipulative tests as predictors of vocational training and job success is questionable.

The reviews by Prediger, Ghiselli, and Patterson also show that the effectiveness of a particular measure as a predictor varies from one vocational program or job to another. It seems to be impossible to conclude that any one or two measures would be most effective with all vocational fields. Other reviews reflect this conclusion.

Stock and Pratzner (1969) reviewed the literature on student selection and prediction of success in occupational education. They include an extensive bibliography and brief summaries of many individual reports. However, few definitive conclusions were reached. Those that were reached tended to agree with the previous reviews.

Crawford (1966) reported on research conducted at the Los Angeles Trade-Technical College between 1952 and 1966. The studies measured individual traits and a variety of separate factors of intelligence. These were examined in terms of their potential for the selection of students for vocational training. During that time, over 8,000 applicants were tested annually, and the batteries of tests were validated for fifty-five trade and technical curricula. Crawford concluded, "Our experience indicates that the IQ tests so generally used in the elementary and secondary schools and the scholastic achievement tests so generally used in combination with high school grade point average to predict college achievement are not the best predictors of success in vocational classes" (p. 1). She went on to say, "Our research leads us to the conclusion that measurements of individual traits and separate factors of intelligence followed by empirical combinations of these measures into aptitude test batteries specifically designed and weighted to predict success in specific areas of training within a specific institution is a far better approach to the problem" (p. 1).

Miller (1968) conducted a study of the ability of a battery of standardized tests to predict the success of high school students in fourteen state vocational schools in Connecticut. The tests used were the Flanagan Aptitude Classification Test FACT), the Gordon Occupational Checklist, the Stanford Achievement Test, the Primary Mental Abilities Test, the Gordon Survey of Interpersonal Values and the Differential Aptitude Test. Test scores were correlated with student scores on written theory tests, performance tests, and a combination of the two. It was found that specific subtest scores were the best predictors for each of the occupational areas.

Bowers et al. (1975) conducted a study of the Armed Services Vocational Aptitude Battery as a predictor of success in high school vocational courses. Data were gathered on 6,130 students from a number of different states. It was concluded that the test could predict success in a variety of vocational curricula. Expectancy tables were developed for twenty-eight civilian high school vocational courses.

As part of its Career Planning Program (CPP) validation in 1970, the American College Testing (ACT) Program prepared a comprehensive study of the ability of pre-enrollment data to predict future vocational program performance (ACT, 1970). The program was designed "as the foundation for a comprehensive and meaningful career development program in postsecondary institutions and high schools seeking to prepare students for postsecondary transition" (p. 2). It assesses vocational interest, ability, work-related experiences, and personal factors relevant to vocational and educational planning. In order to validate the data obtained from this program, ACT conducted both predictive and classification studies. The predictive studies are reviewed here. The classification studies will be reviewed later.

Data were gathered on 16,700 students enrolled in eighteen programs using form F of the CPP. Students were enrolled in twenty-six different institutions across the nation. The predictive studies were accomplished using zero-order and multiple correlation techniques. The predicted criterion of success was the average first term grade in a vocational program. (Academic courses were not included in the average.) In order to be included in the study, people had to have an average of over 2.0 (C) in the vocational courses. The results of calculating zero-order correlations between each of the separate measures obtained from the CPP and the criterion indicated that "generally, the ability measures correlated higher with grades in programs having content that appears to be logically related. For example, the quantitative predictors (math usage and numerical computation) are relatively better predictors of grades in science and technical fields; mechanical reasoning is

better in trades fields; and reading skills is related to grades in most fields" (ACT, 1970, p. 44). The study concluded that the individual zero-order correlations between individual predictors and the criterion were not high. Forty-seven percent (152 out of 324) of the zero-order correlations were below .30.

Multiple correlations also were calculated between the predictors and the criteria for each of the vocational programs studied. Because of small numbers of people in the groups, only three predictors were used in each case. The particular variables selected were those that had a logical relationship to the particular vocational program.

Multiple correlations between the predictors selected for a program and the criterion of first quarter course grades were calculated for each school that provided data for that program. The multiple correlations varied substantially from one school to another. For example, the multiple correlations related to the auto-mechanics program ranged from .20 to .75 with a median of .50. The median correlations for the eighteen programs ranged from .30 to .65; only two were below .40. Although these median correlations were not high, they were relatively high when compared to data obtained from other similar studies.

Another comprehensive study of the ability of standardized test instruments to predict the success of post-high school students was Project MINI-SCORE. A unique characteristic of this study was that it investigated the predictability of a variety of criteria for defining vocational student success. This study produced many reports with the majority of the findings summarized in the five-volume final technical report (Pucel et al.,1972) and the final report (Nelson and Pucel, 1972). The project also conducted both predictive and classification studies. The predictive studies are reviewed here, and the classification studies will be reviewed later.

Data were gathered on over 17,000 applicants who applied to the post-high school Minnesota area vocational-technical schools between 1966 and 1968. Six instruments were selected for inclusion in the test battery, which measured a wide range of abilities and needs. These instruments were the General Aptitude Test Battery (GATB), the Minnesota Vocational Interest Inventory (MVII), the Minnesota Scholastic Aptitude Test (MSAT), the Vocational Development Inventory (VDI), the Sixteen Personality Factors Questionnaire--Form C (16 PF), and the Minnesota Importance Questionnaire (MIQ). These instruments, plus a student information sheet, were administered to students upon application to vocational programs. Information was then gathered on those admitted and

enrolled, drop-outs, graduates, and on how satisfied graduates were with their employment one year after graduating. In addition, employers were contacted to determine how satisfactory graduates were as employees one year after graduation.

The ability of the test instruments to predict a variety of different criteria for judging student success has been reported (Pucel et al., 1972a). The objectives of this substudy were (1) to determine the ability of each instrument to predict the various criteria of success in various vocational populations (i.e., how well could each instrument predict each criterion of success in different populations?); (2) to determine the relative ability of the different instruments to predict each criterion of success across various vocational populations (i.e., which instrument could best predict each criterion of success across populations?); and (3) to determine which subset of the combined scales of all of the instruments in the Project MINI-SCORE battery was most effective in predicting a given criterion.

The population of Minnesota post-high school area vocational-technical school students included in the substudy represented nine separate groups. Six of the groups represented three primarily male and three primarily female occupational curricula. The other three represented the total project population, the total population of males, and the total population of females. Multiple and zero-order correlation analyses were performed for each population, taking scores obtained from students upon application to the schools and correlating them with each of eleven different criteria of vocational student success. The criteria were (1) graduation versus dropping out of the program, (2) being employed in a job related to training versus being unemployed or employed in an unrelated job one year after graduation, (3) being employed in a job related to training one year after graduation versus dropping out of the program.

All of the correlation analyses resulted in quite low correlation coefficients. Of the total of 231 multiple correlations calculated between the instruments and the criteria within the three total populations, only five of the correlations were above .20. Table 3 indicates which criterion was most predictable by each instrument for each of the three total populations. For example, for the "total population," the GATB was most able to predict the "employed related versus drop" criterion.

The Project MINI-SCORE findings pertaining to the ability of an instrument to predict the various crteria of vocational student success across vocational populations led to the

TABLE 3

CRITERION MOST HIGHLY CORRELATED WITH A GIVEN INSTRUMENT IN EACH OF THE THREE POPULATIONS*

INSTRUMENTS	TOTAL POPULATION	TOTAL MALE POPULATION	TOTAL FEMALE POPULATION
GATB	Employed Related vs. Drop	MSS-Promotability Competence	Employed Related vs. Drop
MVII	Employed Related vs. Drop	MSS-Promotability Competence	Employed Related vs. Drop
16PF	Employed Related vs. Drop	MSQ-Extrinsic Satisfaction	MSQ-Extrinsic Satisfaction
MIQ	Employed Related vs. Drop	Employed Related vs. Other	MSQ-Intrinsic Satisfaction
VDI	Employed Related vs. Drop	Employed Related vs. Other & MSS-General Satisfaction	Employed Related vs. Drop
Personal Data	Employed Related vs. Drop	Employed Related vs. Drop	MSS-Conformance
MSAT	MSS-Promotability Competence	None Significant	MSS-Promotability Competence

From (Pucel et al., 1972a)

*This table indicates which criterion of success was most predictable by each instrument for a given population.

conclusion that an instrument cannot predict the same criterion of success equally well across different vocational populations. None of the instruments was most highly correlated with the same criterion consistently across all three total populations or the six curriculum populations. The relationship between an instrument and a given criterion changed from population to population, implying that an instrument might be most effective for predicting one criterion of success in one population and more effective for predicting a different criterion of success in another population.

The Project MINI-SCORE findings pertaining to the relative ability of the different instruments to predict each of the separate criteria of vocational student success across different vocational populations led to the conclusion that student interests, job needs, and personality were the key factors related to the success of the students studied. The MVII, MIQ, and 16PF were predominantly the best predictors of the various criteria of success of vocational students across vocational populations.

The findings pertaining to the "best" composite subset of scales from all of the Project MINI-SCORE instruments led to the conclusion that there is little agreement among the specific instrument scales that are most predictive of a given criterion of success in different populations.

These findings support the conclusions of the other studies previously discussed in this paper, that it is almost impossible to find one instrument that will do a good job of predicting success in different programs or jobs. They also suggest that the best instrument for predicting success in a vocational program will tend to change depending upon the criterion of success used with that program.

"The overall conclusions of this particular Project MINI-SCORE substudy are that the use of standardized test instruments as devices for predicting success in an occupation should be questioned. The relationships between the standardized tests included in the project and eleven criteria of vocational student success were very low. If one does wish to predict such success, however, dimensions such as interests, job needs, and personality appear to be the most effective" (Pucel et al., 1972a, p. 3).

Summary of Prediction Studies

In summary, the literature concerning the prediction of success in vocational programs, and later success on the job, presents a relatively consistent message:

1. It does not appear to be possible to identify one instrument or group of instruments that is consistently effective in predicting success, either in a variety of vocational training programs or in a variety of jobs. However, the limited data available on the ability of measures of job needs, interests, and personality factors to predict vocational student success suggest that they should be investigated further.

2. It is possible to identify specific instruments that are capable of predicting success in a particular vocational program or in a particular job.

3. Measures of manual dexterity have questionable value in terms of predicting success in vocational training or on the job.

Classification Studies

As compared with the number of prediction studies that have been done, relatively few studies can be found in the literature based on the concept of classifying potential vocational students in terms of their similarity to groups that have been successful in either training programs or on the job. Each of the studies that has been found, however, supports the conclusion that there are differences in the characteristics of people who tend to be successful in one vocational program or job as compared with other vocational programs or jobs.

Doerr (1967) found that the thirteen variables measured by the Dailey Vocational Test and the Minnesota Vocational Interest Inventory were capable of significantly differentiating eleventh and twelfth grade vocational students in eight vocational groups.

Prediger (1969) also found that secondary vocational student groups could be differentiated by interest and aptitude measures. He devised a system for plotting two discriminant scores so that one could see the relationships graphically among the distributions of scores for the twenty-two vocational programs studied.

Kapes (1972) conducted a study of the ability of the General Aptitude Test Battery (GATB), the Occupational Values Inventory (OVI) and the Vocational Development Inventory (VDI), as well as a number of family background variables, to differentiate between successful and unsuccessful academic and vocational students. Subjects of the study were 458

ninth grade, male students who attended vocational or academic curriculums at Altoona Senior High School and who had completed the tenth grade. The only variables that did not significantly differentiate the successful vocational, unsuccessful vocational, successful academic, and unsuccessful academic students were the finger and manual dexterity scales of the GATB. "The results of this study confirmed the hypothesis that successful students in the academic and vocational curricula differed on many of the characteristics used in this study" (Kapes, 1972, p. 26).

As indicated in the previous section on prediction studies, the American College Testing Program (ACT) did a series of studies in 1970 to validate their Career Planning Program (CPP). Since background information on that program was discussed earlier, only the results of the classification studies are presented here.

ACT investigated the ability of the CPP to differentiate among students enrolled in various vocational, technical, and transfer programs based on interests, abilities, and working condition preferences of students. Discriminant analysis was used to determine the ability of the ACT/CPP measures to differentiate "successful and satisfied" students enrolled in various vocational, technical, and transfer programs. Twenty-two educational programs were studied - seventeen involving men and fourteen involving women. The analyses indicated that information on working condition preferences, vocational interests, career-related past experiences, and job values was more related to differences among groups who were successful and satisfied in various programs than were ability measures or self-estimates of abilities. The measures that were most effective in differentiating the educational programs were as follows: "For men, the grades, technical, and social scales on the Vocational Interest Profile are the most effective.... Health interest is the most effective variable for females" (ACT, 1970, p. 62).

The section on prediction studies also indicated that Project MINI-SCORE conducted classification studies as well. Since background information on Project MINI-SCORE was discussed earlier, only the results of the classification studies are presented here. The results of the Project MINI-SCORE studies that addressed classification are reported (Pucel et al., 1972b). This report summarizes the results of two Project MINI-SCORE substudies aimed at determining the extent to which pre-enrollment standardized test instrument data are capable of providing meaningful information that can be used to differentiate persons who are later successful in different vocational programs and occupations. One study

examined the ability of each separate scale of an instrument to differentiate groups, and the other investigated the ability of each of the total instruments to differentiate groups. The investigations were conducted using two different definitions of vocational student success. The first was successful graduation; the second was successful graduation plus employment in a related occupation one year after training.

The population of Minnesota post-high school area vocational-technical school students included in these studies was divided into three subparts. The first contained those people enrolled in curricula with predominantly male enrollment; the second contained those people enrolled in curricula with predominantly female enrollment; and the third contained those people enrolled in occupational curricula that included both males and females without a predominance of either sex. The analyses were conducted separately, based upon the sex of the individuals included in the different curricula. This was done because previous project analyses indicated that the scores of people on standardized tests varied.

The results indicated that there were significant differences among the types of people who entered and succeeded in different occupations on those factors measured by the standardized instruments included in the Project MINI-SCORE test battery. These differences were reflected in both the analyses of each of the separate scales of each of the instruments and the analyses of each of the instruments as a whole using each of the two definitions of success. Each of the scales of the GATB, MVII, VDI, and MSAT revealed significant differences while some of the 16PF and MIQ scales revealed significant differences. The largest differences among the groups were found using the MVII. This finding, that interests tended to be most effective in terms of differentiating the groups, is consistent with the findings of the ACT study. The analyses relative to the total instruments also indicated that it is possible to cluster occupations based on the characteristics of people who enter them. However, the occupational clusters derived through the use of the different standardized tests differed somewhat, depending upon the constructs measured by an instrument.

In light of the findings of these Project MINI-SCORE substudies, and as part of the project, three methods of presenting counseling information to students were developed. The first was a method using norm profiles; these were published in a series of norm booklets. The second was a graphic method based upon discriminant analysis using a pictorial presentation of the differences between groups. Using this method, the

score of potential students can be plotted so that individuals can see on a graph which groups they appear to be most like. The third method utilized a computer approach. This methodology is termed the Centour methodology; its application as used in Project MINI-SCORE is described by Pucel (1969).

Summary of Classification Studies

In summary, the results of the classification-type studies found in the literature appear to present consistent findings. They indicate that it is possible to differentiate people who tend to be successful in different vocational programs based on data obtained from standardized instruments. They also present meaningful ways of presenting this information to students. These results imply that is is possible through this method to give a person valuable information that could be used to explore occupational alternatives.

SUMMARY

The results of this review and synthesis of the literature are mixed, depending upon whether one is speaking of the results of predictive studies or classification studies. Regarding predictive types of studies, there are no generalizable criteria that can be used by people selecting and admitting vocational students to optimize student selection and admission for a wide range of vocational programs. This seems to be true, regardless of whether one defines success in terms of training success or job success.

This does not mean it is impossible to develop highly specific sets of criteria to predict success in a specific curriculum within a particular school. The studies conducted at the Los Angeles Trade-Technical College (Crawford, 1966) and findings of other researchers point this out. However, there seems to be little promise that one or two selected and developed instruments could be administered to large numbers of students and used to predict their potential success in a range of vocational programs.

There does appear to be promise, however, for predicting success by using information classification methodologies. These methods would allow students to be compared with people who have been successful in a variety of training programs or occupations, since research has shown that people who tend to be successful in different occupations or training programs do differ in terms of characteristics measured by standardized instruments. Based on these data comparisons, students could be informed about the extent to which they compare favorably or unfavorably to various characteristics typical of successful people in specific training programs or occupations. Although this is possible, some researchers criticize this approach because it is not possible to guarantee that the characteristics that differentiate successful people in different training programs are really those characteristics related to success in the programs. People who select this

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methodology must, therefore, be careful in their selection of the characteristics to be measured and be sure those characteristics show promise of being related to success in the programs or occupations.

In conclusion, it is again important to point out that most research done in the past on selecting and admitting students has been done by studying groups of students who had enrolled (or were about to enroll) in vocational programs, or who had entered (or were about to enter) a job. These methodologies have been, and are still, widely accepted. However, affirmative action considerations now raise questions about using past data developed on groups that were sex biased, racially biased, or biased in terms of representation of the handicapped or disadvantaged. Before using past research, or when planning future research concerning the admission and selection of vocational students, these issues must be considered.

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